Thermal Transport and Properties in Nanostructured Materials

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At nanoscale, thermal transport can deviate significantly from macroscale, leading to significant size dependence thermophysical properties. This presentation will give a few examples from our research to illustrate distinct thermal transport characteristics at nanoscale and their potential applications. In one example, interfaces in nanostructured bulk materials have led to low thermal conductivity, which can be exploited to improve the thermoelectric figure-of-merits. Using nanostructured thermoelectric materials and a novel device design, high-performance solar thermoelectric generators have been developed. In an opposite example, thermal conductivity of polymers can be improved over 300 times by exploiting strong bonding in the carbon backbone and one-dimensional heat conduction along the molecular chain. We will also show that nanoscale graphite flakes added into fluids and solids can lead to significant improvements in their thermal conductivity, and phase-change can be exploited to regulate thermal and electrical conductivities of such composites.